Japan

Name: Japan Tunnelling Association
Type of Structure: Non profit organization
Number of Members: Total number 1446, number of corporate members 203

ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

WGs: JTA consists of the following four committees and each committee has WGs and task forces.
Technology/International Communication/ Events/Public Relation
In each committee, the main activities are:

- Investigation, research and information interchange on general techniques and on subjects from specific projects.
- Meetings such as online lectures, online symposiums and online workshops and online training: "Two-days online seminars" and "Online lectures on topics of the year" (organized by the Events committee)
- Publication of reports and documents: Monthly journal"Tunnels and Underground"
- International cooperation

CURRENT TUNNELLING ACTIVITIES

The Ikejima section of the Aokuzuretoge pilot tunnel on the San-Ennanshin Expressway is a tunnel with a standard excavation cross section of 5.7m in diameter, a section length of 1,168m (total length: 5,014m), and a maximum overburden of 625m. The location of the tunnel is close to the Median Tectonic Line, which is one of the world's largest faults and runs through Japan for about 1,000km from eastern Kyushu to the Kanto region (with a separation of about 500m), and has a complex geology that is difficult to predict in advance. In addition, the tunnel is subject to deformation due to the fragile ground consisting mainly of gouge (fault clay) and fault gravel caused by the intense fault movement of the Median Tectonic Line and the large overburden.

In order to collect three-dimensional information, three types of three-dimensional frontal surveys, namely seismic prospecting reflection survey, electromagnetic resistivity survey, and borehole logging, were carried out in addition to conducting advanced boring surveys to understand the location of the fault zone in front of the face, geological structure and water retention. Based on the results of these investigations, 3D FEM analysis was carried out to investigate the support structure. From the results of the three-dimensional frontal survey, it was estimated that there was a fault crush zone where the ground strength was further reduced in the section with the maximum overburden. Therefore, it was feared that the designed support structure would not ensure the stability of the tunnel, and it was decided to consider the use of a double support structure. A 3D FEM analysis was carried out to reflect the detailed three-dimensional geological data obtained from the exploration results, the displacement of shotcrete and the stress generated in the main support structure, and the double support structure was constructed after the test construction.

The geological conditions along the Median Tectonic Line are far more complex and fragile than assumed at the time of design. For such rapidly changing and difficult-to-predict ground conditions, 3D computerized construction, in which the state and distribution of fault crush zones and fragile layers are realised by multiple 3D frontal surveys and the support structure is studied by three-dimensional numerical analysis, was an effective means of advanced preparation. We were able to excavate the crush zone section with the maximum overburden without deformation or excess displacement of the support structure.

FUTURE TUNNELLING ACTIVITIES

The Sotetsu-Tokyu Direct Line is a 10km long line that connects the Sagami Railway, mainly in the Kanagawa Prefecture, with the Tokyu Railway, which operates in southwestern Tokyo, and is under construction for completion in the second half of FY 2022. The Shin-tsunashima Station to be built in Yokohama City will be an underground station with an island platform at a depth of about 35m, over four levels. The majority of the station will be constructed using open-cut construction, but the 34.5m long Tokyo side of the station, which is 240m long in entirety, will be constructed using trenchless methods because of the presence of buildings, including a hospital, above ground.

To construct the trenchless section of the station, we adopted an advanced construction method for the outer shell considering the geology and its impact above ground. Shafts in Japanese rail stations are set up on the departure and arrival sides, and the propulsion machines used to build the outer shell

are recovered and reused in the shafts on the arrival side. However, in this construction area, it was impossible to install a shaft on the arrival side due to the ground condition, so machine recovery presented an issue. To address this, we developed a self-propelled truck to retrieve the propulsion system, which enabled us to reuse the propulsion system without a shaft.

In addition, the square element propulsion method, which is new technology, was adopted to achieve a horseshoe cross-section with a longer construction length and larger cross-section than the conventional method. A square element is a box-shaped cross-section (1000mm x 1000mm) of steel plates welded together to form a single element, with concave and convex joints connected.

In the construction of a square element, the propulsion machine is driven into the ground by extending the pressing jacks in the launching shaft, and the subsequent elements are connected one after another. For rectangular element propulsions, the position of the propulsion machine becomes the position of the main structure, so strict excavation accuracy is required. In this construction section, the excavation length was long, and each element had a different angle in a horseshoe shape, so it was important to ensure the excavation accuracy. Therefore, to secure the digging accuracy, a new hydraulic correction jack was added to the propulsion system to control and manage not only the vertical and horizontal displacement, but also any rolling.

As a result, the 42 square elements were constructed within the control values. Internal excavation after the construction of the elements was also completed, there was little leakage into the interior and the impact on the ground surface was minimal. We believe that this will help expand the applicability of the trenchless method in the construction of large cross-sectional underground spaces.

EDUCATION ON TUNNELLING IN THE COUNTRY

Hokkaido University, Mururan Institute of Technology, Kitami Institute of Technology, Iwate University, Tohoku University, Akita University, Ibaraki University, Nagaoka University of Technology, Tokyo Institute of Technology, Yokohama National University, Niigata University, Kanazawa University, University of Yamanashi, Gifu University, Nagoya University Nagoya Institute of Technology, Toyohashi University of Technology, School/Graduate School of Engineering, Osaka University, Tottori University, Ehime University Faculty of Engineering, Kumamoto University, Kagoshima University, University of the Ryukyus, Maebashi Institute of Technology, Osaka City University, Hokkai-Gakuen University, Tohoku Gakuin University, Tokyo University of Science, Nihon University, Hosei University, Tokyo City University, Ritsumeikan University, Setsunan University, Fukuoka University, Ashikaga University, Kindai University, Okayama University, Kyushu Institute of Technology, Nagasaki University, University of Miyazaki, Kanazawa Institute of Technology, Meijo University, Aichi Institute of Technology, Osaka Institute of technology, Osaka Sangyo University, Kanazawa University, Kansai University, School of Science and Technology Graduate School of Science and Technology Gunma University, Saitama University, Kyushu Sangyo University, Shibaura Institute of Technology, Chubu University, Tokyo Denki University, Tohoku Institute of Technology, Nagaoka University of Technology, Hachinohe Institute of Technology, Hiroshima University, University of Fukui, Yamaguchi University, National Institute of Technology, Kagawa College, National Institute of technology, Kochi College, National Institute of Technology, Toyota College,National Institute of Technology (Kosen), Kure College, The University of Tokyo, Tokyo Metropolitan University, Waseda University, Kokushikan University, Yokohama National University, Chiba Institute of Technology, Ustunomiya University, Osaka Institute of Technology, Kyotot University, University, Kobe University

STATISTICS

1. Length of tunnels excavated

23.8% mechanized /58% conventional during 2021

2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2021

About US$32bn